

Soyuz 9 Return Samples: Assessment of Air Quality Aboard the International Space Station

The toxicological assessments of 10 dual sorbent tubes (DSTs), one grab sample canister (GSC), and 12 pairs of formaldehyde badges returned aboard Soyuz 9 are reported. Analytical methods have not changed from earlier reports. The recoveries of the less volatile surrogates from the DSTs (including controls) averaged 95 and 99 %; however, ^{13}C -acetone was only recovered at an average of 56 %. Correction factors were applied to volatile polar compounds. Formaldehyde recoveries from 3 positive controls were 59, 78 and 84%.

The two general criteria used to assess air quality are the total-non-methane-volatile organic hydrocarbons (NMVOCs) and the total T-value (minus the CO_2 and formaldehyde contributions). Control of atmospheric alcohols is important to the water recovery system engineers, hence total alcohols (including acetone) are also shown for each sample. Because formaldehyde is quantified from sorbent badges, its concentration is also listed separately. These four indices of air quality are summarized below:

| Module/Sample | Approx. Date | NMVOCs (mg/m^3) | T Value (units) | Alcohols (mg/m^3) | Formaldehyde (ug/m^3) |
|------------------|--------------|-----------------------------------|-----------------|-------------------------------------|---|
| Lab/Formaldehyde | 11/10/04 | -- | -- | -- | 40 |
| SM/Formaldehyde | 11/10/04 | -- | -- | -- | 29 |
| Lab/DST/Formal. | 12/10/04 | 8 | 0.9 | 5 | 27 |
| SM/DST/Formal. | 12/10/04 | 6 | 0.9 | 4 | 27 |
| Lab/DST/Formal. | 1/07/05 | 7 | 0.2 | 6 | 34 |
| SM/DST/Formal. | 1/07/05 | 8 | 0.5 | 6 | 27 |
| Lab/DST/Formal. | 2/10/05 | 6 | 1.0 | 4 | 35 |
| SM/DST/Formal. | 2/10/05 | 7 | 1.0 | 5 | 25 |
| Lab/DST/Formal. | 3/9/05 | 7 | 0.7 | 5 | 35 |
| SM/DST/Formal. | 3/9/05 | 7 | 0.3 | 5 | 28 |
| Lab/GSC | 3/9/05 | 8 | 0.8 | 5 | -- |
| Lab/DST/Formal. | 4/13/05 | 8 | 0.8 | 7 | 39 |
| SM/DST/Formal. | 4/13/05 | 6 | 0.6 | 4 | 33 |
| <i>Guideline</i> | | <25 | <1.0 | <5 | <120 ¹ |

¹ A new long-term SMAC has been provisionally accepted by the National Research Council Committee on Toxicology and by the NASA Toxicology Group.

All formaldehyde concentrations were well within the new long-term SMAC. The Lab samples continue to show slightly higher values than the SM samples. The T values and NMVOCs are essentially within acceptable guidelines; however, the total alcohol levels periodically exceed the guideline of $5 \text{ mg}/\text{m}^3$ set to protect the water recovery system. The bumps of the T Values to 1.0 were caused by traces of acrolein, benzene, and/or dimethyldisulfide being present in some the samples. Although the air samples are sparse, there are no indications that air quality has degraded aboard the ISS.

Enclosures

[Table 1: Analytical Concentrations of 9S DST and GSC Air Samples](#)

[Table 2: T-Value Calculations of 9S DST and GSC Air Samples](#)